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NASA TECH BRIEF
John F. Kennedy Space Center

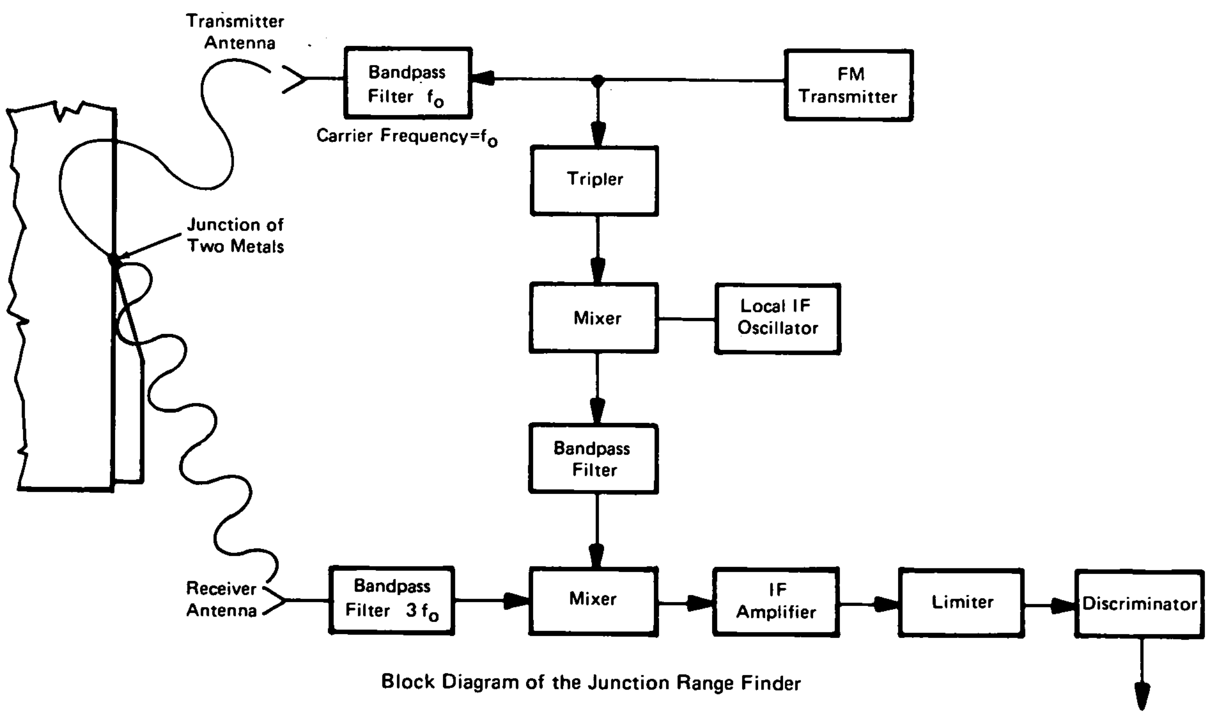
Junction Range Finder

The problem:
Radar systems that are part of complex electronics in space vehicles and aircraft are sometimes subject to interference from surrounding objects. Specifically, objects that comprise several metallic surfaces forming physical junctions with each other exhibit nonlinear electrical impedances. The signals reflected from these junctions bear information which does not correspond to the object distance. Wrong information of this nature may cause serious interferences in the radar reception. Naturally, these sources of interference must be located and corrected.

The solution:
An electronic system was built to locate these sources of interference.

How it's done:
The system as shown in the figure utilizes a well known FM-CW (frequency-modulated continuous-wave) technique to locate objects with nonlinear impedances. In operation, an FM transmitter generates a signal through a bandpass filter which eliminates the higher order harmonics around the carrier frequency. The signal is then radiated through the transmitting antenna. A portion of this signal, used as a reference, is fed to a tripler and then combined in a mixer with a local IF oscillator. This signal is fed through a bandpass filter into the second mixer to be combined with the signal reflected from the target.

When the transmitted signal strikes a nonlinear object, it generates electrical currents on the object surface. These currents produce higher order harmonics



Block Diagram of the Junction Range Finder

(continued overleaf)

in the reflected signal. The reflected signal is picked up by a directional receiver antenna designed to match with the third-order harmonic of the carrier. This signal is then mixed with the reference signal in the second mixer. Because the received signal is time-delayed with respect to the reference signal, the phase difference contains the object range information. The output of the mixer is then amplified, limited, and fed into the discriminator. The amplitude of the discriminator output is directly proportional to the distance of the object and is given by

$$\nu_o(t) = K \frac{\Delta f \omega_m R}{c}$$

where $\nu_o(t)$ is the amplitude of the discriminator output, K is a proportionality constant, Δf is the frequency deviation, ω_m is the modulating frequency, R is the range to the object, and c is the velocity of signal propagation.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Kennedy Space Center
Code AD-PAT
Kennedy Space Center, Florida 32899
Reference: TSP73-10191

Patent status:

This invention has been patented by NASA (U.S. Patent No. 3,732,567). Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

Patent Counsel
Kennedy Space Center
Code AD-PAT
Kennedy Space Center, Florida 32899

Source: Sarto Morissette, Ronald G. Sea, and
Marvin J. Frazier of
Illinois Institute of Technology
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